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A VIBRATORY APPARATUS FOR PRODUCING DROPS OF UNIFORM SIZE

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An apparatus for producing drops of uniform size has been developed in connection with a recent laboratory study of the behavior of individual drops within the size range normally encountered in insecticide sprays applied from aircraft. The drops are formed on and removed from a capillary by a vibrating finger at the rate of 60 drops per second.

Construction

A simple 6-volt electromagnet (M in accompanying figure) is connected in series with the secondary of an 8-volt doorbell transformer, the primary of which is fed from a variac off the 110-volt line. The finger (F) is made from a piece of wire from a paper clip (diameter 0.036 inch) about 1/2 inch long, approximately half of which is flattened knifelike by hammering and filing. It is soldered to the end of a short length of hacksaw blade (B) with the flattened part projecting and with the flats at right angles to those of the blade. The other end of the blade is fastened to the base with a clamp so that the blade extends about 2 1/2 inches and the free end bearing the finger is in front of the electromagnet. By projecting the blade more or less beyond the clamp it can be made to vibrate "in tune" with a 60-cycle current producing a 60-cycle-per-second vibration, the magnitude of which can be adjusted by the variac.

A capillary (C) is drawn from a length of larger tubing (T), the undrawn part of which forms a reservoir for the liquid. The capillary is held vertically in front of the finger by an adjustable support with the tip of the capillary slightly below the level of the finger. Slide-control mechanisms (K) make possible a fairly fine adjustment in the position of the capillary relative to the finger. The magnitude of vibration is best when the finger almost touches the capillary at its nearest point of

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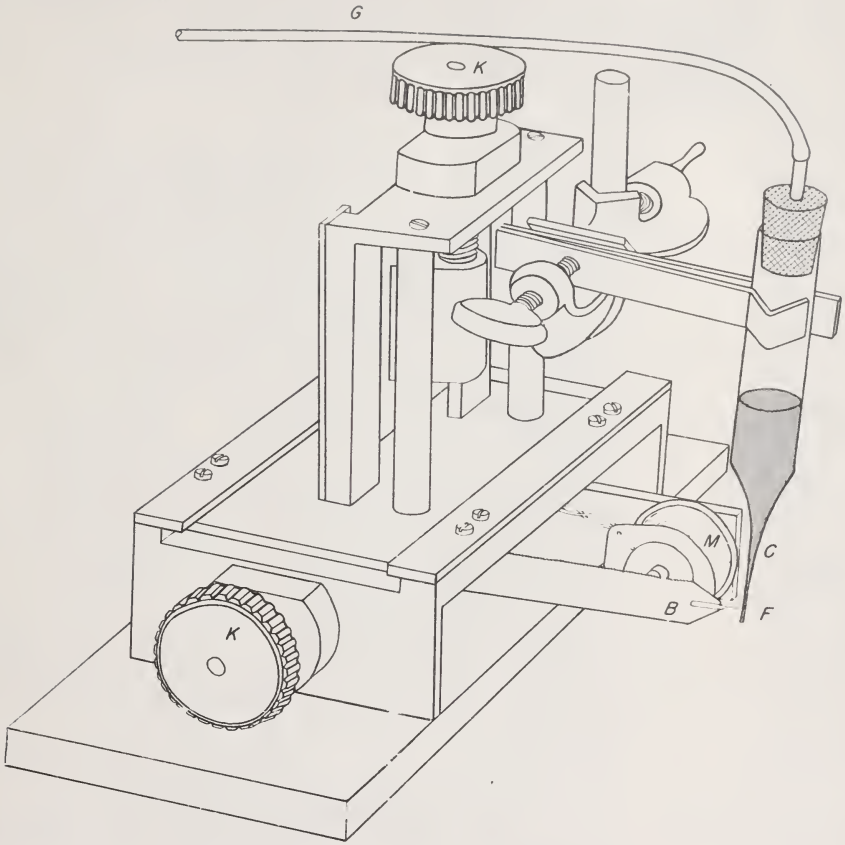
1/ In cooperation with the Division of Farm Machinery, Bureau of Plant Industry, Soils, and Agricultural Engineering.

approach. Usually it is also necessary to apply a slight, controlled air pressure to the surface of the liquid within the reservoir. A water bubbler teed into the tube G is used to control this pressure. The water bubbler consists of a glass tube through which the excess air flow is allowed to escape under water. It has seldom been found necessary to apply a pressure of more than a few inches of water.

Operation

Slow-motion movies of the apparatus in operation show that the following action takes place during one cycle (1/60 second) in which one drop is produced. Liquid is forced out of the capillary by the pressure behind it until a small drop begins to take shape. Early in its formation this drop rises on the outside of the capillary and makes a sort of torus, or ring, around it. It does not rise far, but takes up a stationary position, where it increases in size by the addition of material from the capillary. The correct vertical position at which to adjust the capillary is with the finger at the level of this torus. The finger approaches until it makes contact with the torus; then the drop begins to transfer to the finger. However, because of the high acceleration of the finger the material drops off as the finger recedes.

When properly adjusted, uniform drops are produced at the rate of 60 per second, the succession of drops streaming in a single line as they leave the apparatus. The stream seldom falls directly downward but usually is projected outward. It is seen most easily when a light beam is played upon it. The drops are so nearly uniform in size that measurements under the microscope reveal no variation. When these drops are of oil, and are collected on a film of water, they will arrange themselves in perfectly aligned rows. This action would take place only if the drops were uniform. By using various sizes of capillaries and different pressures it has been found possible to make oil drops of any desired diameter between 6 and 140 microns. The machine has been used only on oil solution.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